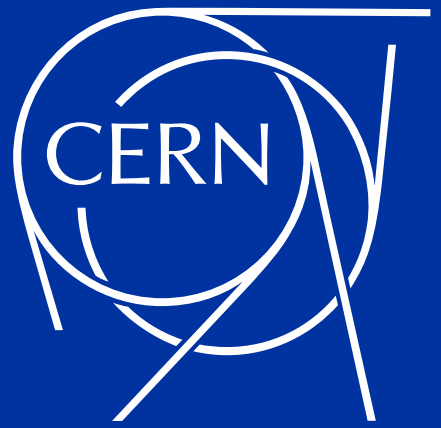

Welding techniques

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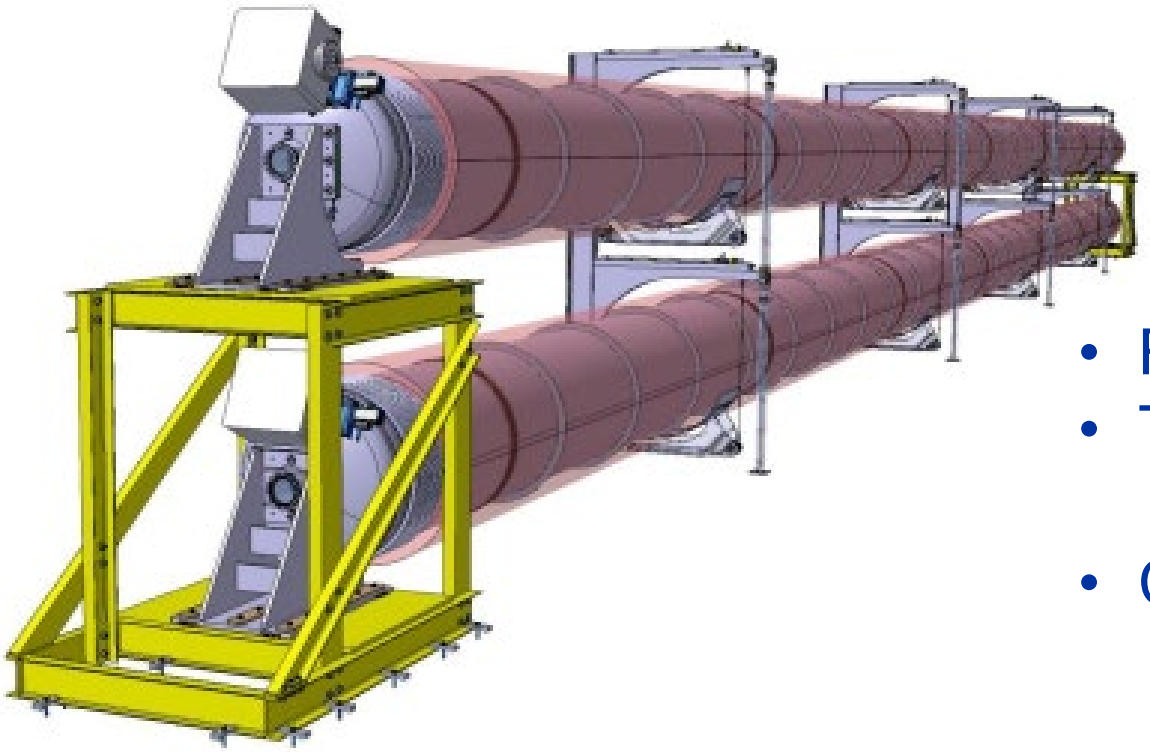
Gilles Favre

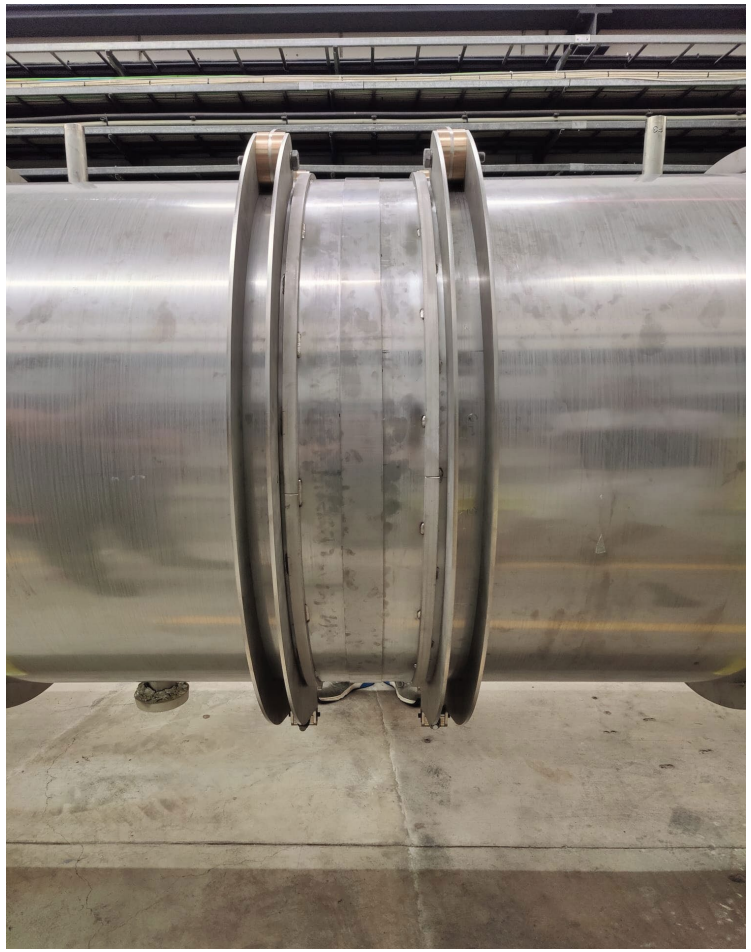
Welding techniques

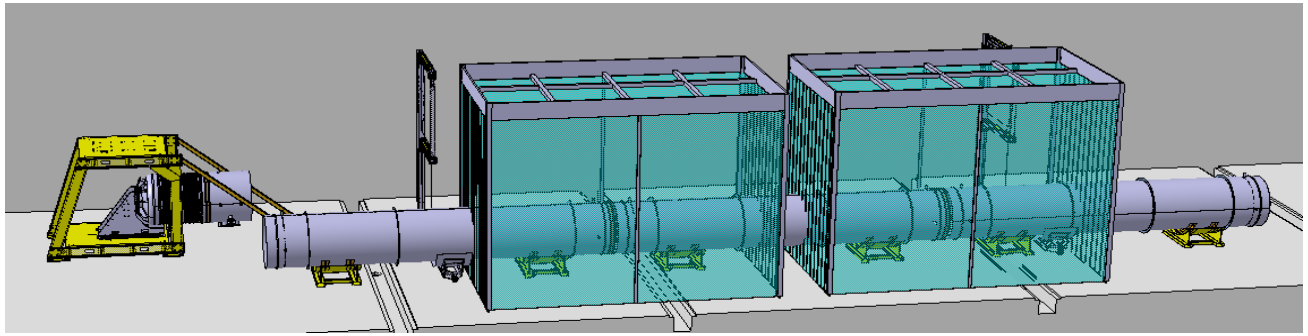


Information to consider :

- Roundness of the parts to be joined
- Type of assembly
  - Butt weld / Fillet weld / Lip weld
- Choice of process
  - Automatic process
  - Manual process
- Welding to then be able to cut for future repairs
- Accessibility

Welding techniques



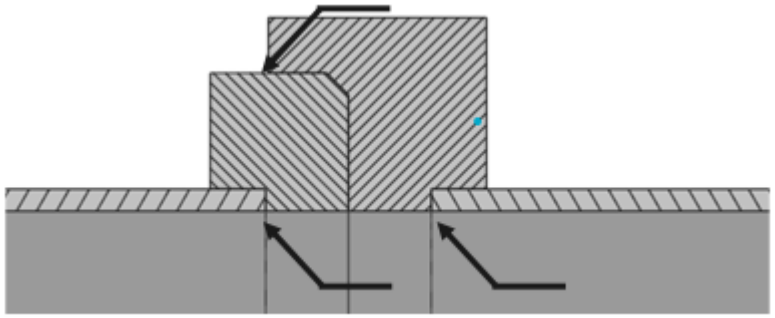


First line will be weld manually at CERN :

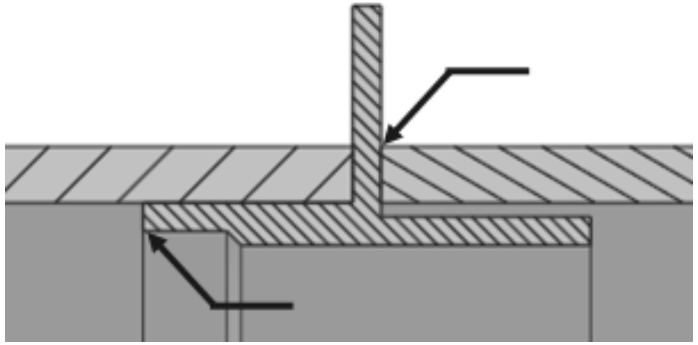
- Modular roundness tool positioned at the end of each tubes
- Close sleeve in 4mm thickness with 1mm gap
- Manual fillet welding
- TIG process with filler material 317L
- Possibility to cut the sleeve while limiting internal dust contamination of the tube

Welding techniques

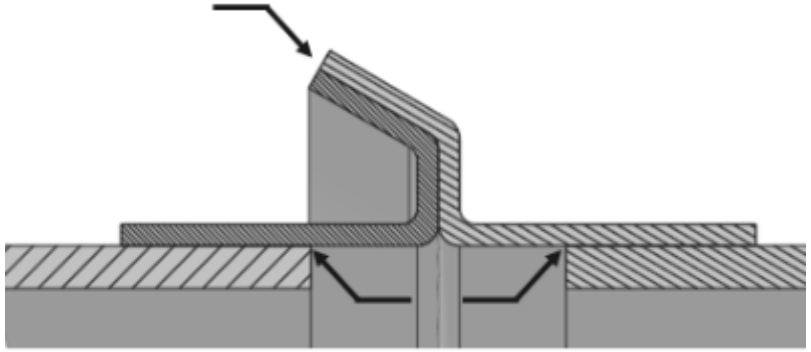
- Other joint assembly discuss



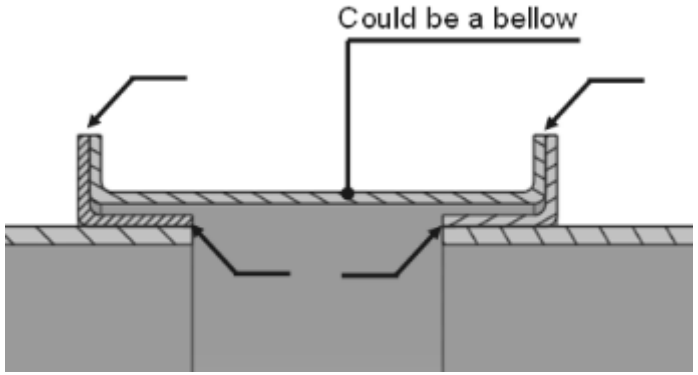
FLANGE



CENTERING RING-LIKE



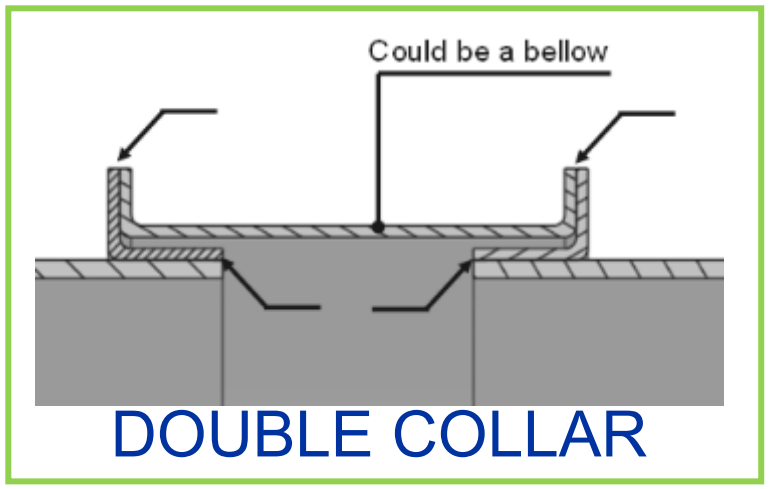
INCLINED LIP



DOUBLE COLLAR

Welding techniques

- Other joint assembly discuss

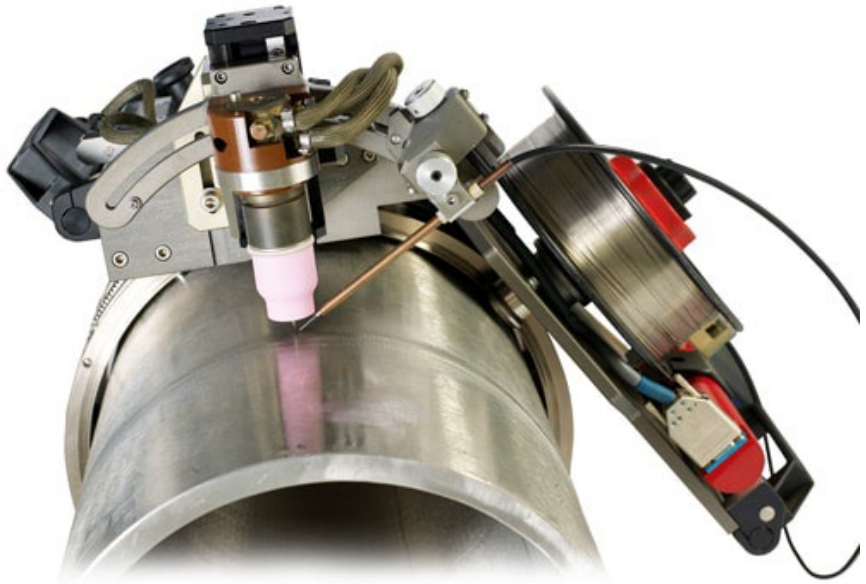


DOUBLE COLLAR

Second line discussion:

- No machining for tubes ends
- Tolerant to extremities roundness
- Collars could be made by spinning metal
- Cut and welding out of tube direct view
- Central part can be replaced by a below

Welding techniques



Chromium guide rings for all tube and pipe O.D.s

Information for 2nd line :

- An orbital TIG welding machine (Polycar 60) is available at CERN and can be easily borrowed.
  → Estimated cost saving: 40,000 CHF
- The track associated with the available machine has a diameter of 650 mm

Discussion for 2nd line :

- With the current **650 mm track**:
  1. Tilting the welding head at 45° to perform a fillet weld on a sleeve is not possible.
  2. The double collar/lip weld assembly proposed (manufacturing option) is not feasible for a 650 mm diameter.
- If purchasing a **larger track (>1008 mm diameter**) – Estimated cost: 15,000 CHF
  1. Tilting the welding head at 45° for a fillet weld on a sleeve is still not possible.
  2. Possibility to **test double collar/ lip weld configuration** (currently in production) in vertical welding position.
  3. This would require:
     - Fabrication of two flanges (viroles) at 1008 mm diameter,
     - Assembly of the new lip weld configuration onto the flanges,
     - Vertical testing using the orbital TIG welding machine.
  4. The >1008 mm track is custom-made, lead time approx. 3 months.

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Welding techniques

	1st Beamline (baseline)	2nd Beamline (proposal)	Demonstrator (PoC, alternative)
Manufacturing route	7 × 6 m AISI 441 sections 1.5 m rings welded circumferentially 4 x stiffeners AISI 304L tack welded	Same provider, 6 m sections Improved/more stiffeners Better fixturing and welding sequence Different interconnections/bellows	3 m length prototype From 3 m x 1.5 m AISI 441 plates Thickness to be defined since reduced thickness could allow autogenous welding…
Status & Strategy	**Completed:** Lessons learned	**Conditional procurement**: 1 × 6 m trial → validate with metrology before full production	**Exploratory:** **Two half-cylinders** with longitudinal welds Spiral welding from coil Other
Achievements & Advantages	100% leak-tight welds UHV specification met	Build on proven welding process Vendor know-how Available material in 4 mm	To test alternative forming/welding route PoC useful for ET beamline design strategy Reduce number of interconnections Simplify QC (NDTs and leak-tightness inspection)
Main issues	Circularity deviations at ends Banana shape over 6 m Sleeve assembly difficult	Risk of repeat → mitigated by trial section before scale Validation of alternative interconnection	Feasibility of forming/fixturing long half-shells
Timeline	**Done** (2025)	**Urgent:** Start trial Q4-2025 → full line Q3-2026 Manufacturing design ASAP	**Flexible:** Launch MS Q4-2025 → PoC Q3-2026 Scale later if promising

Welding techniques

POLYCAR 60-2

Open carriage-type welding head
for welding of tube and pipe joints

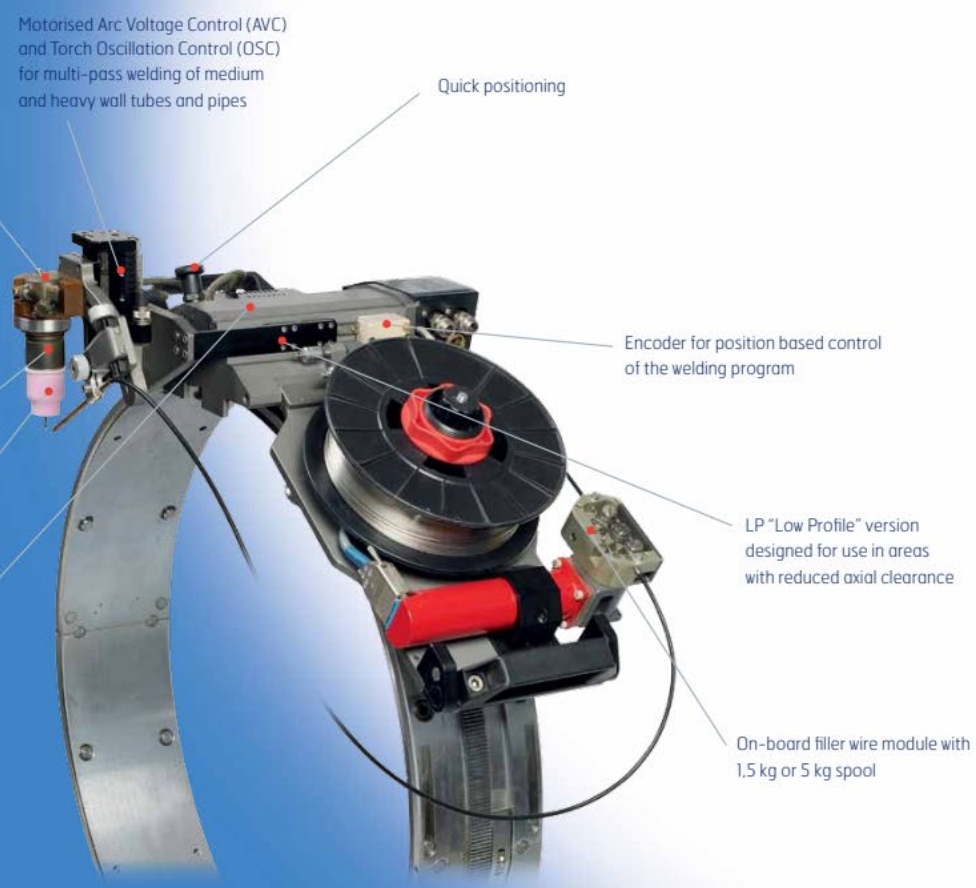
Highest flexibility and quality

Advantages

- Minimal radial and axial clearance
- Modular design for orbital TIG Cold Wire and Hot Wire welding
- Perfectly adapted to tube and pipe welding of medium-sized and heavy wall thicknesses
- Reproduces all movements of a manual welder and completes the weld in a series of passes
- Especially designed for welding under difficult conditions in workshop or on site
- Narrow Gap Welding for further productivity increase

Resulting from 50 years' experience in mastering welding technologies

General characteristics




Torch block with AVC/OSC cross slides and adjustable wire guide


On-board wire feeder with straightening device


Chromium guide rings for all tube and pipe O.D.s


Torch module "V2 Narrow Gap", for wall thicknesses up to 75 mm